

PROSPECTUS
FOR
SEOUL CITY GAS PLANT

October, 1971

The Government of the Republic of Korea
Seoul, Korea

PROSPECTUS
FOR
SEOUL CITY GAS PLANT

October, 1971

Summary of the Project

1. Project Title : Seoul City Gas Project
2. Project Sponsor : Metropolitan Government of Seoul

3. Estimated Required Fund :
Foreign capital : \$ 15,621,179
Local Capital : ₩ 6,639,878,000

4. Project description:

Establish and operate city gas plant for the domestic, commercial and industrial gas demand in Seoul City. The initial 8 years project will produce 300,000m³ of gas with 7,000 Kcal/m³ of calorific value, the breakdown of which is 258,000m³ for domestic consumption and 42,000m³ for commercial and industrial uses.

5. Project Benefit:

Through conversion of anthracite briquette to naphtha city gas, the efficiency of fuel utilization in Seoul will increase from 38.5% contributing considerably to the national fuel saving.

Since 56.2% of Korean fuel is now imported, fuel saving is now directly related to foreign exchange saving, favorable trade balance and self-sufficiency in Korean economy as a whole.

On the other hand, the citizens of Seoul City will enjoy the convenience of modern fuel at less cost, less labor in fuel handling, cleaner home and town as a whole, less gas poisoning, and saving in city budget by eliminating ash disposal expenditures.

Table of Contents

Summary of the Project

I. Nature of the Project

- A. Introduction & Background 2
- B. Project Description 3

II. Applicant

- A. General Features 8
- B. Description of Gas to be Manufactured 8
- C. Present Fuel Method 8
- D. Organization Chart 9

III. Technical Aspects

- A. General Features 11
- B. Engineering Data 12
- C. Site Selection 12
- D. Plan of Operation 13
- E. Demand 13
- F. Overall Technical Soundness 13

IV. Economic & Financial Aspects

- A. Estimated Capital Cost 15
- B. Working Capital Requirements 18
- C. Running Cost 18
- D. Gas Rate 19
- E. Profitability 19
- F. Ability of Project to Meet Cost 22
- G. Benefit - Cost Analysis 23
- H. Analysis of Associated Benefits 23

Section I. Nature of the Project

A. Introduction & Background

- a. The purpose of this project is to manufacture city gas in Seoul for domestic, commercial and industrial uses in order to replace the present anthracite briquette as far as possible.
- b. The modernization of fuel system is necessary to increase overall efficiency of fuel efficiency, for saving in coal handling labor, ash disposal city budget and national transportation load; for cleaner homes and city as a whole; and for less gas poisoning and air pollution.
- c. Through adoption of a modern gas fuel system, housewives can save considerable time formerly required to replace the briquette and remove its ash, and to clean the house and wash the clothing, now required more frequently due to the use of anthracite briquette. Although anthracite is cheaper by calorific value, gas could be used at higher fuel efficiency, thus the consequent gas cooking bills are less.
- d. The supply of city gas can encourage high accuracy industries using high convenience fuel, such as brown tubes for television, transistors and aluminum tapes for electronic industries, enameled decorations and art wares, christmas bulbs, etc. City gas will also be suitable for small scale domestic industries requiring less capital but considerable employment of skilled labor.

B. Project description

- a. The proposed Seoul city gas project will establish two gas plants with a total capacity of $300,000\text{m}^3/\text{day}$ of $7,000\text{ Kcal/m}^3$ gas with locally available naphtha as feed stock, distribute the gas through gas holders, pipes and metering system to each consumer, billing and collecting the gas proceeds under an integrated management.

Since a city gas project is a public utility enterprise, the establishment and management of this gas enterprise will be supervised, protected and controlled by the Government by the Gas Law to be promulgated in the near future.

With a reasonable gas billing rate, the consumers can profit from cheaper fuel cost while the proposed project will be able to pay back the loan with sufficient profit under adamant financial stability. For such purpose, the project sponsor has to use low interest loan with sufficient repayment period, in accordance with general practices of city gas industry in other countries. In order to reduce the interest payment, a low interest foreign loan is necessary, as the proposed gas project is government endorsed after sufficient feasibility studies.

b. Forecast of Gas Demand

Unit: Household

Supply plan by Year

| <u>By year</u> | <u>Southern Area</u> | <u>Eastern Area</u> | <u>Total</u> |
|----------------|----------------------|---------------------|--------------|
| 1971 | 5,000 | | 5,000 |
| '72 | 20,000 | | 20,000 |
| '73 | 25,000 | | 25,000 |
| '74 | 25,000 | 15,000 | 40,000 |
| '75 | 25,000 | 25,000 | 50,000 |
| '76 | 20,000 | 30,000 | 50,000 |
| '77 | 15,000 | 40,000 | 55,000 |
| '78 | 15,000 | 40,000 | 55,000 |
| Total | 150,000 | 150,000 | 300,000 |

Southern construction project for 150,000 households and eastern construction project for 150,000 households were made on the basis of supply plan shown in the foregoing paragraph.

c. Present status of project

A gas plant producing $3,000\text{m}^3$ of $7,000\text{ Kcal/m}^3$ of butane is in operation under Seoul city management, the distribution system of which will be used to supply naphtha gas when it will become available in 1972.

d. Fund

The estimated foreign currency requirement for this project is \$15,621,179 for the procurement of gas plant, instruments and equipment not produced in Korea; and the estimated local Fund requirement is ₩6,639,878,000 for purchase of site, construction of buildings, installation of gas pipings, machineries and equipment produced in Korea.

Under current exchange rate, the won value of dollar is approximately 375 W.

e. Engineering service

The designing, fabrication, installation, start up operation and operator training program will be serviced by Foreign Engineering Groups, while piping will be installed under the responsibility of the local contractors. No engineering difficulties are expected because parties concerned are well experienced in the field in which they are to partake.

Preliminary and detailed feasibility studies have been made to decide the gas demand and marketability, suitability of raw material, gas - making process and product gas quality as well as distribution system layout.

f. Procurement of loan financed

Procurement by new loan in 1972 will be made in close coordination with financier's concurrence.

The loan requirement details are available in the master plan but the procurement cost will be decided annually in accordance with current market quotations and price index.

g. Construction.

Plant construction will be executed by the project sponsor under the supervision and guidance of the plant maker.

All laborers, workmen, technicians, skilled or unskilled, are available in Seoul where considerable similar work is being carried out..

h. Operation and maintenance

Plant operators will be trained during and after the plant construction, both in the field of basic engineering knowledge and actual operation on-the-job know-how. Maintenance men will be trained in the same way so that both operators and maintenance men will become capable of running the plant when the initial and start up operation is completed under the supervision and guidance of plant manager.

i. Soundness of Project

This project is sound and feasible because

- (1) Demand of gas fuel is fast increasing along with total increment of fuel demand with increasing population and fast expanding industries.
- (2) High efficiency utilization of economic and convenient modern fuel is necessary to cope with the economic development of the country.
- (3) Modernization of fuel system is necessary along with modernization of the country as a whole.
- (4) City gas industry is now a common practice in Japan, U.S. and other countries and can well replace existing system of anthracite briquette in its cost and convenience.

The project sponsor believes that this project is sound in all respects both economically and technically, thus no difficulty will result in paying back the loan in scheduled time.

SECTION II. APPLICANT

A. General Features

Name : Metropolitan Government of Seoul,
Republic of Korea.

Present status : Population : 5,536,377 (End of 1970)
Number of household : 1,091,015
(End of 1970) 300,000 to get gas
supply.

Estimated per capita annual income
in 1970: \$402.40

Similar present operation: Water service, bus and
sewage system are under the manage-
ment of Seoul Metropolitan Government,
all of them in satisfactory financial
condition.

B. Description of Gas to be Manufactured

Raw material : Naphtha produced in Korea

Product gas : Calorific value: 7,000 Kcal/m³

Weaver's Flame Speed Index: 30.3

Specific gravity (Air as 1) : 0.67

Approximate Gas Analysis:

| | | | |
|-------------------------------|------|-------------------------------|--------|
| CO ₂ | 4%, | C ₂ H ₄ | 21%, |
| C ₃ H ₆ | 3%, | O ₂ | Trace, |
| CO | 6%, | H ₂ | 26%, |
| CH ₄ | 24%, | N ₂ | 16%, |

C. Present Fuel Method

Although propane, kerosen and electricity are used
as minor heat source,

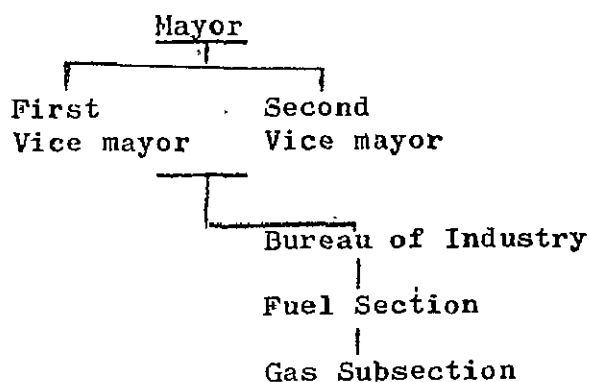
about 85% of 13,500,000 tons of annual anthracite production is consumed as household fuel in the form of holed briquette, beside which fire wood and agricultural by-products are used as country-side fuel in Seoul, anthracite briquette occupies 84.4% of the total fuel consumption, oils occupy 15.1% and propane 0.5%. Since Korean anthracite is difficult to ignite, anthracite briquette is kept burning at all times even during the hot summer days when only 9% of the heat generated is used for cooking. During winter time, the heat after cooking is used for warming Ondol, thus the heat efficiency is around 68% thus giving an annual average heat efficiency of 38.5%.

Since the naphtha gasification efficiency is around 90% in case of high efficiency N.R.G process and the efficiency of gas combustion is 90%, the overall naphtha gas heat efficiency is around 81%.

In addition to the fact that anthracite briquette has low heat efficiency, changing briquettes in the braziers, ash removal, briquette delivery, etc., involves huge labor, transportation load, dust from handling briquette ash which requires more house cleaning and clothes washing; and Co and So₂ gas evolved from briquetted combustion are severe menace to health by Co poisoning and air pollution to whole city.

D. Organization chart

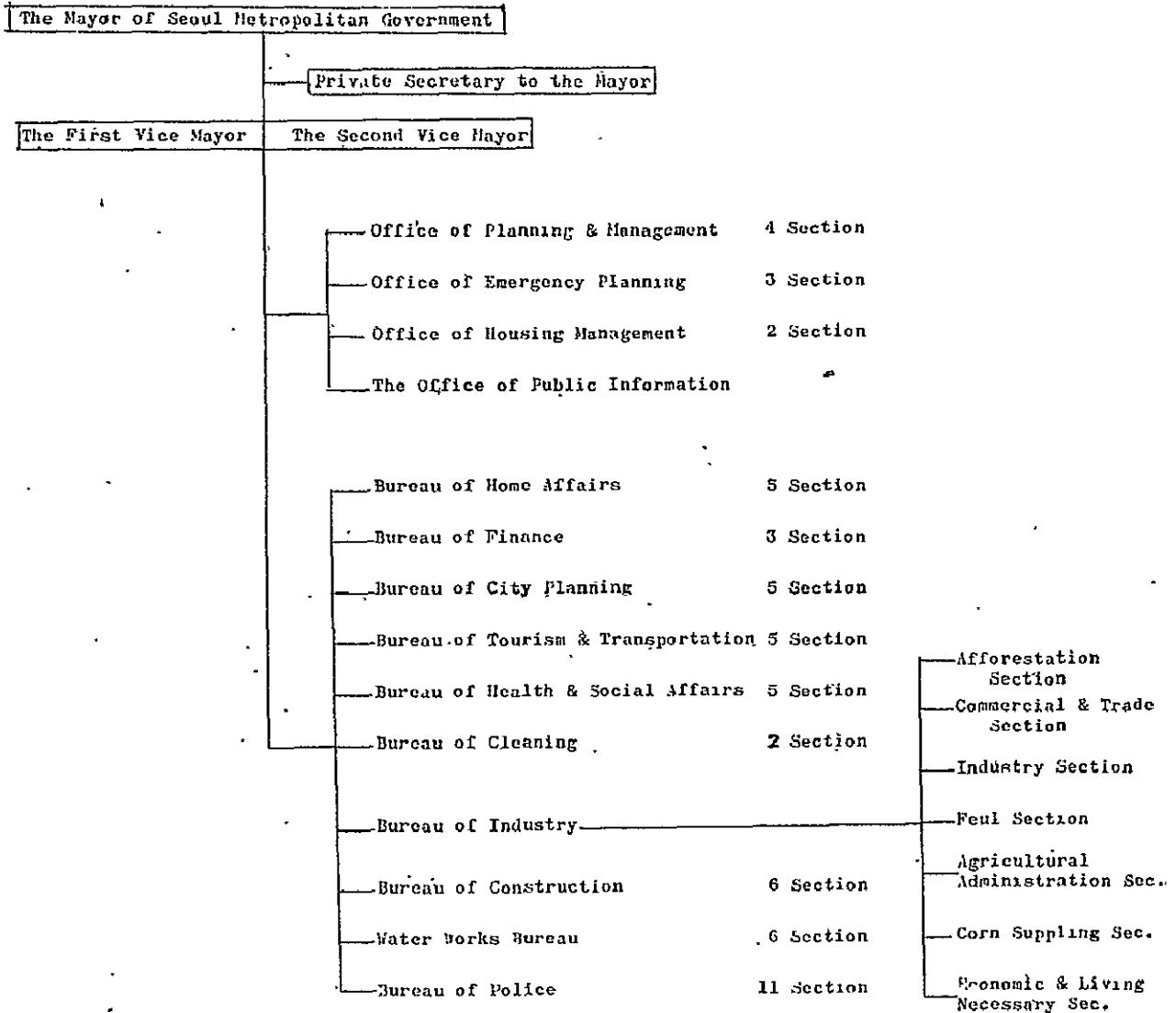
a) Existing



If the project should begin in earnest on the basis of this project design, Seoul city will have another separate organization of Bureau class for this project by 1975 at latest, and the business administration criteria to be applied to this project will be under the Municipal Utility Law, in Korea, made on the basis of Self-financial system.

ORGANIZATION CHART OF SEOUL METROPOLITAN GOVERNMENT

As of Aug. 1971



III. Technical Aspects

A. General Features

This project has the advantage of using cheap naphtha as the feed stock, the comparison of which being as follows:

| | | |
|------------------|-------|------|
| Light oil | 9.66 | W/l |
| Kerosene | 13.04 | " |
| Heavy oil | 7.15 | " |
| Diesel oil | 6.35 | " |
| Bunker C oil | 4.79 | " |
| Light Diesel oil | 8.09 | " |
| Naphtha | 4.70 | " |
| Asphalt | 7.30 | " |
| Propane | 35.10 | W/kg |
| Butane | 25.10 | " |

Although Korean naphtha has extremely high sulphur content (Korean 0.12% British 0.01 - 0.02% Japanese 0.026%), through selection of suitable gasification process (NRG process) high sulphur raw naphtha will be used as feedstock without desulfurization step, to desulfurize the product gas to acceptable standard of 0.5 gram/m³ of product gas.

NRG process can produce high calory gas without catalyst or methanization step, thus saving considerably in gas holder and piping size.

The NRG gas generator could be operated continuously unlike cyclic gas generator, with wide range of raw materials by a little adjustment in the equipment prior and subsequent to the reactor with no change in reactor itself.

The calorific value of the product gas can be adjusted freely with adjustment in operation conditions.

The gas transmission is planned to be executed under high pressure in the long distance main pipes, under a pressure of around 9Kg/Cm^2 , while service pipes to consumers will maintain a pressure of around 170mm W.G. requiring no individual pressure regulator at consumer end.

B. Engineering Data.

The process of gas making and gas distribution is similar to those widely used in Japan with many years of operation history, thus sufficient engineering data is available for this project, although utilization of local materials, equipment and machinery requires close check up by expert tests, analysis and inspection to see whether they are fit for the original specifications.

C. Site selection.

Two sites will be selected because one $150,000\text{m}^3/\text{day}$ plant will be built in Yungdeungpo area while another plant will be built in Tongdaemoon area,

The plant site in Yungdeungpo area has already been decided along the highway to Kimpo air field with a space of 5.185 pyong (17,140 square meter).

Transport of naphtha to this site will be convenient from Inchon or from railroad station in Yongsan or Seoul.

The pipings of the two plants will eventually meet together at the center of Seoul City because construction of gas plant at the center of Seoul City is not feasible economically and, from safety point of view.

D. Plan of operation

Seoul City will establish and operate two gas plants under its own responsibility as no civilian enterpriser can do the same under the present circumstances.

However, when this project can establish itself as stable business, may be in ten years or so, as foreseen by financial forecast, this project will be sold to civilian enterprisers as has been done in the case of Tokyo Gas or Osaka Gas Company.

Incidentally Tokyo Gas has the third largest proceeds in Japanese business.

E. Demand

The city gas under this project will be sold mainly for cooking purpose at the start but consumption for space heating will gradually increase with the increase in European type houses and improvement in heating system of Korean type houses.

The demand for cooking is estimated at $0.86\text{m}^3 - 1\text{m}^3/\text{day}$ of $7,000 \text{ Kcal}/\text{m}^3$ gas.

The consumption tendency of butane and propane air gas at I-chondong indicates that steady and positive increase in demand will develop for city gas under the prevailing economic circumstances.

F. Overall Technical Soundness

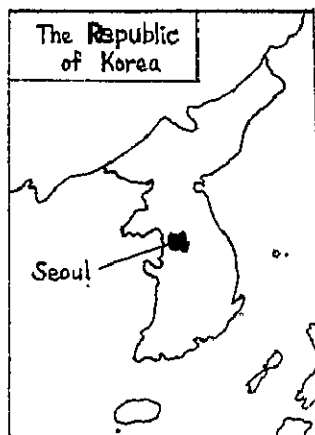
The fast increasing demand of propane gas in Seoul indicates that modernized and convenient gas fuel is gradually in great demand certifying to the economic feasibility of city gas in Seoul.

City gas was in operation from 1909 to 1949 in Seoul. Its rehabilitation was difficult due to the emergence of anthracite as cheap domestic fuel. Thus there is no technical difficulty in this project when low interest funds are available in sufficient amount.

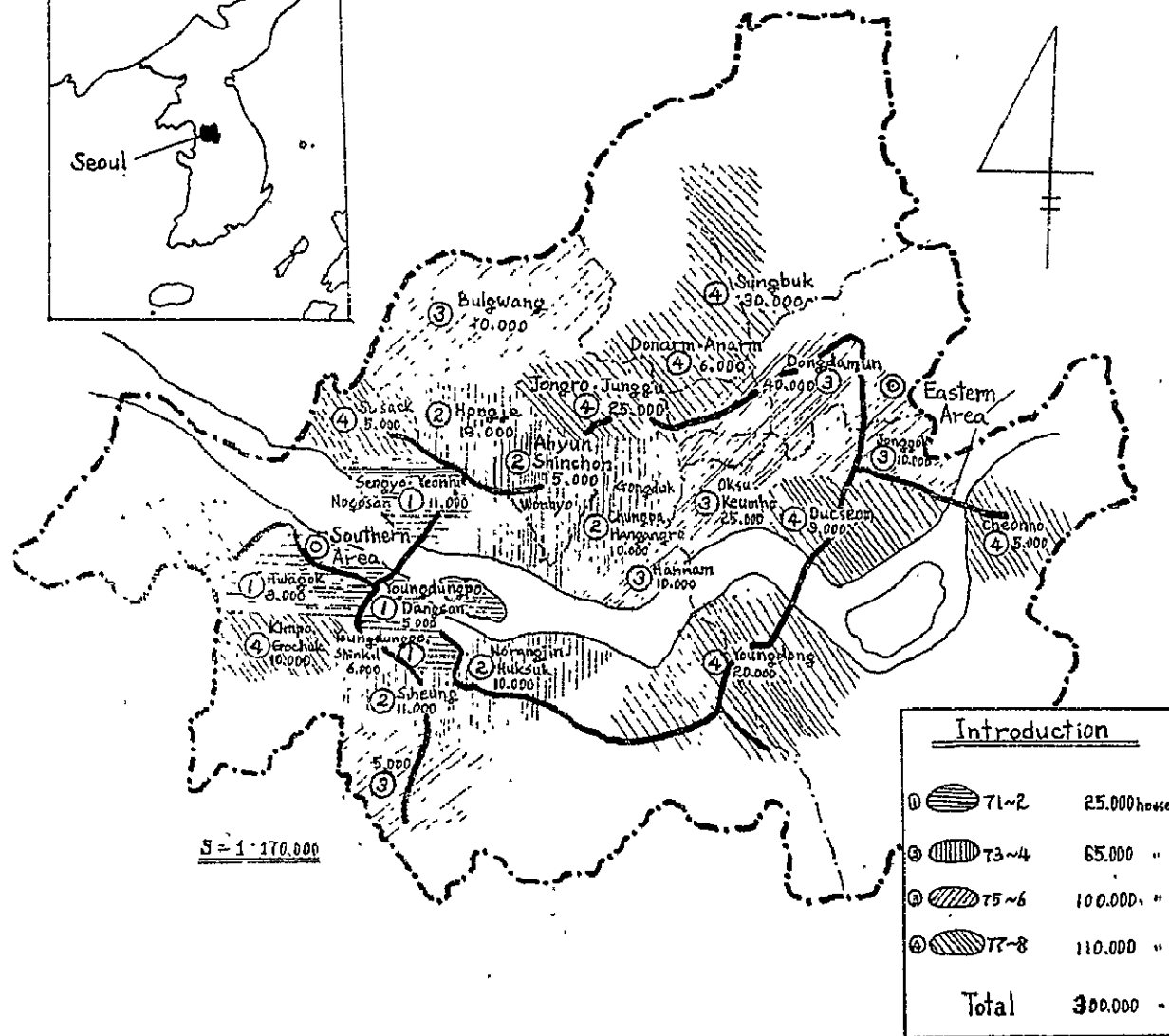
The anthracite coal is no more attractively cheap, due to the increase in ash content from 15% to 30%. The calorific value decreased from 6,000 Kcal/Kg average in 1952 to 4,700 Kcal/Kg in 1970.

Project plan by Years

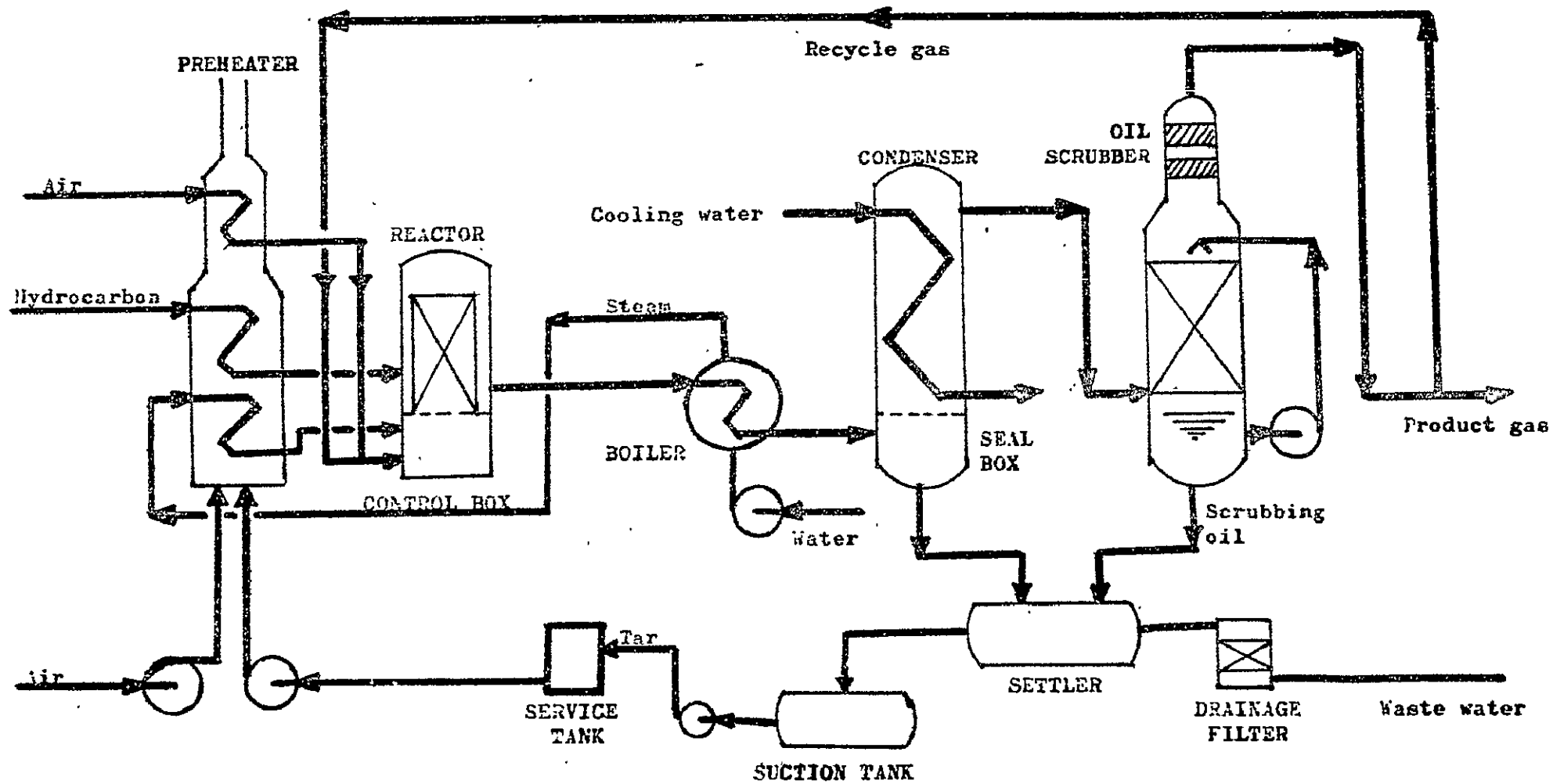
| | | <u>Year</u> | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | Total |
|---------------------|-----------------------|-------------|--------|--------|--------|---------|--------|---------|--------|--------|---------|
| <u>Process</u> | | | | | | | | | | | |
| Manufactory | South Plant | | 50,000 | | | 50,000 | | 50,000 | | | 150,000 |
| | East Plant | | | | | 50,000 | | 50,000 | | 50,000 | 150,000 |
| | (M ³ /day) | Total | 50,000 | | | 100,000 | | 100,000 | | 50,000 | 300,000 |
| Gas Holder | South Plant | | 5,000 | | | 10,000 | | | | | 15,000 |
| | East Plant | | | | | 5,000 | | 10,000 | | | 15,000 |
| | (M ³) | Total | 5,000 | | | 15,000 | | 10,000 | | | 30,000 |
| Distribution system | South Plant | | 5,000 | 20,000 | 25,000 | 25,000 | 25,000 | 20,000 | 15,000 | 15,000 | 150,000 |
| | East Plant | | | | | 15,000 | 25,000 | 30,000 | 40,000 | 40,000 | 150,000 |
| | (house) | Total | 5,000 | 20,000 | 25,000 | 40,000 | 50,000 | 50,000 | 55,000 | 55,000 | 300,000 |



Supply Plan for Town Gas



PROCESS FLOW CHART



Section IV. Economic & Financial Aspects

A. Estimated Capital Cost

1. Land and Right

| | |
|---------------------|----------------------|
| a. Southern project | W 120,000,000 |
| b. Eastern project | <u>W 120,000,000</u> |
| Total | W 240,000,000 |

2. Engineering Costs

- a. Preliminary engineering up to
time of application W 18,000,000 or
\$ 48,450
- b. Design, preparation of contract documents,
supervision W103,000,000 or
\$346,700

3. Construction Costs

Schedule is as follows:

Summary of Estimated Construction Cost

| <u>Item and Description</u> | <u>Fund Requirement</u> | | <u>Total Expressed in</u> | |
|---|-------------------------|------------------------|---------------------------|--------------------|
| | <u>Local Currency</u> | <u>U.S. Dollar</u> | <u>Local Currency</u> | <u>U.S. Dollar</u> |
| 1. Land and Land right | W 240,000,000 | | 240,000,000 | 640,000 |
| 2. Construction Cost | 5,732,026,000 | \$15,046,262 | 11,374,374,000 | 30,331,664 |
| 3. Engineering Cost (Design) | 60,000,000 | | 60,000,000 | 160,000 |
| 4. Engineering cost (Supervision) | 43,000,000 | | 43,000,000 | 114,667 |
| 5. Contingency | 564,852,000 | 574,917 | 780,446,000 | 2,081,189 |
| Total | W6,639,878,000 | \$15,621,179 | 12,497,820,000 | 33,327,520 |
| Portion to be financed by applicant | 6,639,878,000 | | 6,639,878,000 | 17,706,341 |
| Remaining cost to be covered by loan | | \$15,621,179 | 5,857,942,000 | 15,621,179 |
| Total of Fund Source | 6,639,878,000 | 15,621,179 | 12,479,820,000 | 33,327,520 |
| Percentage | Local cost; 53.12% | Dollar cost; 46.88% | | |

Investment Plan of Local & Foreign Fund

Southern Project

| <u>By Year</u> | | '71 | '72 | '73 | '74 | '75 | '76 | '77 | '78 | Total |
|---------------------|--------------|---------|---------|---------|-----------|---------|---------|---------|---------|-----------|
| <u>Division</u> | | | | | | | | | | |
| Manufactory | | 500,009 | 30,000 | | 653,335 | | 263,335 | | | 1,446,679 |
| Distribution System | | 212,362 | 562,855 | 653,557 | 575,538 | 606,068 | 334,686 | 411,312 | 408,006 | 3,064,386 |
| Gas-Meter | | 50,000 | 120,000 | 150,000 | 150,000 | 130,000 | 120,000 | 90,000 | 90,000 | 900,000 |
| | Local Fund | 411,111 | 435,177 | 472,948 | 367,571 | 441,256 | 442,109 | 297,050 | 295,256 | 3,362,478 |
| Total | Foreign Fund | 331,260 | 277,678 | 330,609 | 811,302 | 314,812 | 473,914 | 204,262 | 202,750 | 2,948,507 |
| | Total | 742,371 | 712,855 | 803,557 | 1,378,873 | 756,068 | 918,023 | 501,312 | 498,006 | 6,311,065 |

Eastern Project

| | | | | | | | | | | |
|---------------------|--------------|---------|---------|---------|-----------|-----------|-----------|-----------|-----------|------------|
| Manufactory | | | | | 550,009 | | 653,335 | | 263,335 | 1,446,679 |
| Distribution System | | | | | 382,794 | 611,352 | 736,954 | 1,042,856 | 1,065,923 | 3,840,079 |
| Gas-Meter | | | | | 90,000 | 150,000 | 180,000 | 240,000 | 240,000 | 900,000 |
| | Local Fund | | | | 569,935 | 444,654 | 682,681 | 754,367 | 825,763 | 3,277,400 |
| Total | Foreign Fund | | | | 432,868 | 316,398 | 887,608 | 528,489 | 743,495 | 2,909,358 |
| | Total | | | | 1,002,803 | 761,552 | 1,570,289 | 1,282,856 | 1,569,258 | 6,186,758 |
| | Local Fund | 411,111 | 435,177 | 472,948 | 1,137,506 | 885,910 | 1,124,790 | 1,051,417 | 1,121,019 | 6,639,878 |
| Grand-total | Foreign Fund | 331,260 | 277,678 | 330,609 | 1,244,170 | 631,710 | 1,363,522 | 732,751 | 946,245 | 5,857,945 |
| | Total | 742,371 | 712,855 | 803,557 | 2,381,676 | 1,517,620 | 2,488,312 | 1,784,168 | 2,067,264 | 12,497,823 |

Note : Total contingency costs in the amount of W780,446,000
are distributed to each above item such as Manufactory, Distribution system, Gas-Meter etc.

B. Working Capital Requirements

| | | | |
|------------------|----------------------|----|-------------------|
| Southern Project | W 150,000,000 | or | \$ 400,000 |
| Eastern Project | <u>W 150,000,000</u> | or | <u>\$ 400,000</u> |
| | W 300,000,000 | | \$ 800,000 |

C. Running Cost

| | <u>Southern project</u> | <u>Eastern project</u> | <u>Total</u> |
|---------------------------------------|-------------------------|------------------------|----------------------|
| <u>For the period of Construction</u> | | | |
| Capacity cost | W 3,479,696,000 | W 1,781,109,000 | 5,260,805,000 |
| Commodity cost | <u>W 1,190,325,000</u> | <u>W 567,016,000</u> | <u>1,757,341,000</u> |
| Total | <u>W 4,670,021,000</u> | <u>W 2,348,125,000</u> | <u>7,018,146,000</u> |

Annual Running Cost

After completion of Construction

| | | | |
|-----------------|----------------------|----------------------|----------------|
| Capacity cost | W 934,674,000 | W 914,644,000 | 1,849,318 |
| Commoditiy cost | <u>W 338,109,000</u> | <u>W 338,109,000</u> | <u>676,218</u> |
| | W1, 272,783,000 | W1, 252,753,000 | 2,525,536 |

D. Gas rate

1. Proposed Gas Rate W 35/M³ (7,000 Kcal)
2. Current Gas Rate W 35/M³ (7,000 Kcal)
3. Gross income estimated for the first 10 years
after completion of Project.

Total income from sales of gas: 31,283,000,000

Total expense for the period : 24,341,316,000

Balance (net income) 6,941,674,000

E. Profitability

Analysis of predicted profit & loss, forecast of
earnings and receipts and expenditures.

Unit : 1,000 won

I. Earnings from operations

Revenue

| | Construction period from '71 to '78 | From '79 to '88after construction |
|--|---|---|
| 1. Annual sales (1,000M ³) | 231,623 | 893,800 |
| 2. Unit gas rates per M ³ | 35 | 35 |
| 3. Gross revenue from sales (1x2) | 8,106,837 | 31,283,000 |

Running cost, Net income
& Profit

| | | |
|--|-----------|------------|
| 4. Operating & Maintenance expenses | 1,483,145 | 4,956,000 |
| 5. Depreciation allowance | 2,586,308 | 9,265,410 |
| 6. Commodity cost | 1,757,341 | 6,762,180 |
| 7. Total running cost before on long-term debt (4+5+6) | 5,826,794 | 20,983,590 |
| 8. Net income before interest on long-term debt (3-7) | 2,280,043 | 10,299,410 |
| 9. Interest on long-term debt | 1,191,437 | 3,357,721 |
| 10. Net profit (8-9) | 1,088,606 | 6,941,689 |

II. Source of Funds

| | | |
|---|------------|------------|
| 11. Net income before interest (8) | 2,280,043 | 10,299,410 |
| 12. Depreciation allowance (5) | 2,586,308 | 9,265,410 |
| 13. Aid in construction from general customers | 1,800,000 | |
| 14. Receipts from sales of Gas Meter | 1,800,000 | |
| 15. Fund from Seoul City government | 988,957 | |
| 16. Total receipts of the funds, free interest (11--15) | 9,455,308 | 19,564,820 |
| 17. Foreign Loan | 5,824,957 | |
| 18. Total sources of funds (16+17) | 15,280,265 | 19,564,820 |

Unit : 1,000 won

III. Use of Funds

| | | Construction period from '71 to '78 | From '79 to '88 after construction |
|------------------------------------|-----------|---|--|
| 19. Construction expenditure | | | |
| a) Foreign currency in won | | 5,824,957 | 5,149,705 |
| b) Local currency | | 6,672,866 | |
| Total construction expenditures | | 12,497,823 | |
| 20. Working capital | | 240,000 | 60,000 |
| 21. Debt service | | 1,316,754 | 6,640,217 |
| a) Amortization of principal | | 125,317 | 3,282,496 |
| b) Interest on long-term debt | (3) | 1,191,437 | 3,357,721 |
| 22. Total expenditures | (19--21) | 14,054,577 | |
| 23. Surplus of cash | (18 - 22) | 1,225,688 | 7,714,898 |
| 24. Total use of funds | (22-23) | 15,280,265 | 19,564,820 |

IV. Balance-Sheet, End of Period

| | | End of 1978 | End of 1988 |
|--|----------|-------------|-------------|
| <u>Assets</u> | | | |
| 25. Current assets | | 1,465,688 | 9,240,586 |
| 26. Capital assets | | 12,497,823 | 17,647,528 |
| 27. Gross assets | | 12,717,823 | 26,888,114 |
| 28. Accumulated depreciation | (5) | 2,586,308 | 11,851,718 |
| 29. Net fixed assets | (26-28) | 9,911,515 | 5,795,810 |
| 30. Total assets, end of period | (29+25) | 11,377,203 | 15,036,396 |
| <u>Liabilities</u> | | | |
| 31. Foreign loan | | 5,699,640 | 2,417,144 |
| 32. Fund from Seoul city government | | 988,957 | 988,957 |
| 33. Surplus | | 4,688,606 | 11,630,295 |
| a) Aid in construction | | 1,800,000 | 1,800,000 |
| b) Receipts from sales of gas meter | | 1,800,000 | 1,800,000 |
| c) Earned surplus | | 1,088,606 | 8,030,295 |
| 34. Total liabilities | (31--33) | 11,377,203 | 15,036,396 |

F. Ability of project to meet cost

- for 10 year after completion of project. -

| <u>Division</u> | <u>Southern project</u> | <u>Eastern project</u> | <u>Southern & Eastern project</u> |
|---------------------------------------|-------------------------|------------------------|---|
| Revenue from sales of gas | W15,641,500,000 | W15,641,500,000 | W31,283,000,000 |
| Operating & maintenance | 2,478,000,000 | 2,478,000,000 | 4,956,000,000 |
| Depreciation | 4,731,720,000 | 4,533,690,000 | 9,265,410,000 |
| Interest | 1,654,341,000 | 1,704,380,000 | 3,358,721,000 |
| Commodity Cost | 3,381,090,000 | 3,381,090,000 | 6,762,180,000 |
| Refund to Principal | <u>1,617,614,000</u> | <u>1,664,881,000</u> | <u>3,282,495,000</u> |
| Total cost and refund to principal | <u>W13,862,765,000</u> | <u>W13,762,041,000</u> | <u>W27,624,806,000</u> |
| Balance (+) | W 1,778,735,000 | W 1,879,459,000 | W 3,658,194,000 |

The Balance shows gas rate revenues sufficient enough to cover cost
and refund to principal for 10 years after completion of construction.

G. Benefit - Cost Analysis

a) B/C ratio

Benefit-cost ratios were calculated using analysis period of 30 years at 12%, synthetic discount rates of 7.5 and 15 percent.

Seven and a half percent were applied as the world bank's current rates, and 15 percent were applied as the opportunity cost of capital in Korea.

Applied rates, 12% were calculated as follows:

$$\text{Local fund} : 6,639,878,000 \times \frac{15}{100} = 995,981,700$$

$$\text{Foreign fund} : 5,857,945,000 \times \frac{7.5}{100} = 439,345,875$$

$$100 \times \frac{995,981,700 + 439,345,875}{6,639,878,000 + 5,857,945,000} = 11.5 (\approx 12\%)$$

$$\text{Southern project} : 1,087$$

$$\text{Eastern Project} : 1,105$$

$$\text{Eastern \& Southern projects} : 1.1 (\text{discount rate } 12\%)$$

b) I.R.R.

$$\text{Southern project} : 12.5 - 13\%$$

$$\text{Eastern project} : 12.5 - 13\%$$

$$\text{Southern and Eastern projects} : 13\%$$

The internal rate of return (I.R.R) for the product,

13% is higher than discount rate of 12%

H. Analysis of associated benefits

a) Saving in energy resources

1. Annual briquette demand for 300,000 household:

$$13,500,000 \text{ M/T}$$

2. Combustion efficiency of briquette

$$(\text{domestic use}) : 38.5\%$$

3. Combustion efficiency of town gas: 100%

$$1,350,000\text{M/T} \times 38.3 (\%) = 519,750\text{M/T}$$

$$1,350,000\text{M/T} - 519,750 = 830,250\text{M/T}$$

Annual saving in briquette from loss: 830,250M/T

b) Annual cleaning cost reduced:

1. Annual cleaning expense for 300,000

household.: ₩194,400,000

$$₩0.60 \times 1,080 \times 300,000 = ₩194,400,000$$

₩0.60 : cleaning expense per briquette

1,080 : annual briquette demand per household.

2. Annual cleaning expenditures of Seoul

$$1,350,000\text{M/T} \times 0.36 + 4\text{M/T} \times ₩3,000 = 364,500,000$$

0.36 : Weight per briquette ash

₩3,000: Freight per truck

4M/T : Load capacity per truck.

c) Traffic Saving

Annual railway car required

$$1,350,000\text{m/T} \div 40\text{M/T} = 33,750 \text{ Cars}$$

Annual Truck required

$$1,350,000\text{M/T} \div 4 \text{ M/T} = 337,400 \text{ Trucks}$$

To accomplish this project separately without any subsidy from General Account, we made I. I. R. described in G item, IV section above without considering the associated benefit.